

## **Description**

### **A METAL TANK WITH A SYNTHETIC RESIN SHEET, AND UNIT PANEL**

#### **Technical Field**

- [1] The present invention relates to a metal tank with a synthetic resin sheet, in particular to a metal tank with a synthetic resin sheet and a unit panel for it, which is constructed by engaging a plurality of unit elements in correspondence with the desired volume, each of which is fabricated by attaching a polyethylene sheet harmless to the human body on a portion of one surface of a galvanized iron plate and filling a urethane resin between the other surface of the galvanized iron plate and a metal plate, thereby ensuring excellence in cost competitiveness and waterproof property and durability while being harmless to the human body.

#### **Background Art**

- [2] In general, a rubber lining is good in chemical-resistant property, wear resistant property, high adhesion property, high reliability, and high construction property, as well as economic anti-erosion processing, and easy in repair and maintenance of the defect portions during the use, in comparison with the other organic and inorganic anti-erosion materials, so that it occupies a unique position in the field of the anti-erosion processing and over whole industrious field in spite of the conspicuous development of the plastic industries.
- [3] Conventionally, the rubber lining is one of the anti-erosion technologies about the several chemicals including the sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), and the other harmful gases, which reduce the durability of the iron reinforced concrete and the other structures, and is one of the high-tech anti-erosion method applied to the facilities for preventing the air pollution, facilities for processing the waste waters, the water processing facilities, and the other chemical facilities. Especially, the water-purifying tank employs the rubber lining technology to carry out the water-proof processing in the inside of it.
- [4] Here, the rubber lining is divided into two types, one of which is to form a desired thickness of thick films on the inside wall surface of the water purifying tank by spraying the synthetic resin, and the other type is to attach the synthetic resin sheet.
- [5] In general, the water-purifying tank can be divided into a concrete structure, which is excellence in construction property and cost competitiveness, and a metal water purifying tank.
- [6] In the case of the water purifying tank made of the concrete structure, water-proof structure is accomplished by carrying out a paint after constructing a mortar mixed

with a water proof solution at the inside wall surface of the concrete tank, however, cracks can be produced due to the repeated expansion and contraction of the concrete so that rubber lining is requisitely required. Also, in such a concrete structure type water-purifying tank, the rubber lining should be repaired and conserved by a pre-determined period due to its particular repeated expansion and contraction.

- [7] Further, in the case of the water purifying tank made of the metal material, rubber lining is not constructed in the inside of the tank without at the ceiling surface in which the chloride can be remained, and it uses a harmless stainless steel. However, in such a water purifying tank constructed of the stainless steel, it is not cost competent because the cost of the material for the tank is high.
- [8] In addition, such a water purifying tank made of the stainless steel is provided with a plurality of separate reinforcement angles to reinforce the side portion at the inside and the corner portion to thereby increase the production cost as well as the complexity of the use, making it difficult to clean and wash.
- [9] In order to solve such problems, in Korean Utility Model Registration No. 1,358,000 (Res. date: 1998. 11. 06), there is disclosed a large water tank made of the synthetic resin materials. In this invention, the large tank made of the synthetic resin materials has been manufactured by spraying the polyethylene resin at the inside wall of the of the tank made of the synthetic resin materials, so that the structural defects of the concrete structure can be solved and it has a cost competitiveness in comparison with the water purifying tank made of the stainless steel structure, however, it is very low in durability against the outer force in comparison with the concrete structure and the water purifying tank made of the stainless steel structure. Especially, as for the large or mid scale tank with a big static load or big dynamic load, it has been required that particular reinforcement technology be applied to the inside and outside of the tank.
- [10] Another technology to solve such problems is a SMC (Sheet Molding Compound) tank, in which resin coating is applied to the metal plate made of the stainless steel or steel. Such technology is excellence in hygiene property and earthquake resistant property, however, it is low in cost competitiveness because a special mold is required.
- [11] Accordingly, the structure of the present water purifying tank is urgently required that it is excellence in cost competitiveness as is the concrete structure, and is harmless to the human body as is the stainless steel as well as of a structure not requiring the repair and conservation.

## **Disclosure of Invention**

### **Technical Problem**

- [12] The present invention has been made to solve the above-mentioned problem

occurring in the conventional art, and the object of the present invention is to provide a metal tank with a synthetic resin, which is excellent in cost competitiveness, water-proof function, and durability as well as harmless to the human body.

- [13] Another object of the present invention is to provide a unitary panel with a synthetic resin and a metal tank with such a panel, which is provided with an engagement member having an enhanced thermal insulation property and durability.

### **Technical Solution**

- [14] To accomplish the above objects, according to one aspect of the present invention, there is provided a metal tank with a synthetic resin sheet having a tank body made of a metal material, an inlet pipe and an overflow pipe communicating with an upper portion of the tank body respectively, an outlet pipe and a drain pipe communicating respectively with a lower portion of the tank body, and a ladder installed at an outer wall of the tank body, the metal tank is characterized by comprising: the tank body constructed of a plurality of first unit panels installed to form a bottom surface of the tank body, each of the first unit panels being made by stacking a synthetic resin sheet, a first metal plate, and a thermal insulation material in order, and a plurality of second unit panels installed to correspond to edges of the first unit panels and to form side surfaces and an upper surface of the tank body, each of the second unit panels being made by stacking the synthetic resin sheet, the first metal plate, the thermal insulation material, and a second metal plate in order; a plurality of stay reinforcement members, respective both ends of which are installed at edges of the first unit panels and edges of the second unit panels constituting a ceiling surface of the tank body; a plurality of beam reinforcement members, respective both ends of which are installed at opposing edges of the second unit panels constituting the side surfaces of the tank body, the respective beam reinforcement member being partially welded to the respective stay reinforcement member; and securing means provided to secure the corresponding edges of the adjacent unit panels to the outside wall of the tank body; wherein the synthetic resin sheet is made of a polyethylene, and the first metal plate, the thermal insulation material, and the second metal plate are respectively made of a galvanized iron plate, a foamed urethane, and a painted color steel plate.
- [15] Preferably, the securing means may comprise: an engaging reinforcement plate arranged at corners of the adjacent unit panels; a securing screw for penetrating and securing one side surface of the engaging reinforcement plate, each of the adjacent unit panels; and the other side surface of the engaging reinforcement plate in order; and a nut secured at an end of the securing screw.
- [16] According to another aspect of the present invention, there is provided a unit panel with a synthetic resin sheet comprising: an upper surface plate; side surface plates,

each of which is bent vertically from edges of the upper surface plate and formed with a plurality of securing holes; and at least one tubular securing member provided to penetrate the upper surface plate so that an upper portion and a lower portion are exposed; wherein the plate is consisted of the first metal plate made of a painted color steel plate, a thermal insulation material made of a foamed urethane provided at one side of the first metal plate, and a foamed polyethylene synthetic resin sheet provided at an upper surface of the thermal insulation material and at edges of the first metal plate so that the thermal insulation material can be arranged between them.

[17] Preferably, the upper surface of the securing member may be hermetically sealed with the foamed polyethylene synthetic resin sheet.

[18] According to another aspect of the present invention, there is provided a metal tank with a synthetic resin sheet having a tank body made of a metal material, an inlet pipe and an overflow pipe communicating with an upper portion of the tank body respectively, an outlet pipe and a drain pipe communicating respectively with a lower portion of the tank body, and a ladder installed at an outer wall of the tank body, the metal tank is characterized by comprising: the tank body constructed of a plurality of a first unit panels installed to form a bottom surface of the tank body, each of the first unit panels being made by stacking a synthetic resin sheet, a first metal plate, and a thermal insulation material in order, and a plurality of second unit panels installed to correspond to edges of the first unit panels and to form side surfaces and an upper surface of the tank body, each of the second unit panels being made by stacking the synthetic resin sheet, the first metal plate, the thermal insulation material, and a second metal plate in order; a plurality of stay reinforcement members, respective both ends of which are installed at edges of the first unit panels and edges of the second unit panels constituting a ceil surface of the tank body; a plurality of beam reinforcement members, respective both ends of which are installed at opposing edges of the second unit panels constituting the side surfaces of the tank body, the respective beam reinforcement member being partially welded to the respective stay reinforcement member; and a securing means having an engaging reinforcement plate arranged at corners of the adjacent unit panels and formed with engagement hole, a securing screw for penetrating the engagement hole of the engaging reinforcement plate, the securing member, and an engagement hole of the corresponding reinforcement member in order, and a nut secured at the penetrated end of the securing screw; wherein the synthetic resin sheet is made of a foamed polyethylene, and the first metal plate, the thermal insulation material, and the second metal plate are respectively made of a galvanized iron plate, a foamed urethane, and a painted color steel plate.

### **Advantageous Effects**

- [19] According to the first embodiment of the present invention with the structure described above, it is possible to implement the metal tank, without using high-cost stainless steel, which is harmless to the human body and excellent in durability and waterproof property, and it is good in workability because a painted color steel plate is used in the second metal plate to remove the necessity of separate melt plating or painting.
- [20] Also, in the present embodiment, it is possible to reduce production cost and clean the inside of the tank easily because separate internal reinforcing work is not required, dissimilarly to the SMC tank or the water purifying tank made of the stainless steel.
- [21] In addition, in the present embodiment, workability is good because no welding work is carried out in the inside of the tank, and it is very advantageous for making the tank requiring sanitary work as is in the water purifying tank.
- [22] Further, according to another embodiment of the present invention, it is not only possible to improve the durability by radically preventing the peeling of the interface through the foaming of the polyethylene without using the adhesives, but also to accomplish desirable thermal insulation performance by preventing the compression of the thermal insulation material by means of the engagement member.
- [23] Also, according to the embodiment of the present invention, it is possible to reduce the production cost because the first metal plate is not used in the second unit panel of the metal tank.

### **Brief Description of the Drawings**

- [24] FIG. 1 is a partially cut perspective view of a metal tank with a synthetic resin sheet according to one embodiment of the present invention;
- [25] FIG. 2 is a cross-sectional view showing a portion of the metal tank according to the present invention;
- [26] FIGs. 3 to 6 are cross-sectional views showing a principal portion of FIG. 1;
- [27] FIG. 7 is a perspective view showing a unit panel with a synthetic resin sheet, to which an engagement member is attached, according to the second embodiment of the present invention;
- [28] FIG. 8 is a cross-sectional view of FIG. 7 taken along line  $\square - \square$ ;
- [29] FIG. 9 is a partially taken perspective view showing the metal tank with the unit panel of FIG. 7;
- [30] FIG. 10 is an enlarged cross-sectional view of an engagement portion of the unit panel with a reinforcement member;
- [31] FIG. 11 is a cross-sectional view showing a portion of the metal tank according to the present invention;
- [32] FIG.12 and FIG.13 are enlarged cross-sectional views showing the portions "A-1",

and “B-1” of FIG. 10.

### **Best Mode for Carrying Out the Invention**

- [33] Hereinafter, the metal tank with the synthetic resin sheet, and the unit panel of the present invention will be described in detail with reference to the appended drawings.
- [34] FIG. 1 is a perspective view of a metal tank with a synthetic resin sheet according to one embodiment of the present invention, wherein a portion of the tank is cut out, and FIG. 2 is a cross-sectional view showing a portion of the metal tank according to the present invention.
- [35] Referring now to FIGs. 1 and 2, the metal tank of the present invention is configured to be installed stably on a foundation plate 300 provided above a pad portion 200 separated from each other and is made of concrete material.
- [36] The metal tank of the present invention comprises a tank body 10 consisted of a plurality of first unit panels 10a constituting a bottom surface, and a plurality of second unit panels 10b constituting a side surface and an upper surface, an inlet pipe 40, an overflow pipe 60 and an air vent 80 communicating respectively with an upper portion of the tank body 10, a drain pipe 70 and an outlet pipe 50 communicating with a lower portion of the tank body 10, and also a ladder 90 is mounted at an outer surface of the second unit panel 10b for use of the tank, cleaning of the inside of the tank, and repair and conservation of the tank.
- [37] Here, the inlet pipe 40 and the air vent 80 are communicated with the upper surface of the second unit panel 10b constituting the upper surface of the tank body 10, the overflow pipe 60 is communicated with the upper side surface of the second unit panel 10b constituting the side of the tank body 10.
- [38] The drain pipe 70 is communicated with the first unit panel 10a, and the outlet pipe 50 is communicated with the lower side surface of the second unit panel 10b constituting the side of the tank body 10.
- [39] Edges of the first and second unit panels 10a, 10b are bent outwardly, and the respective adjacent unit panels 10a, 10b are positioned for the bent portions be contacted with each other and be engaged with each other by means of the securing means 30 to the outward direction of the tank body 10.
- [40] In the present invention, a plurality of stay and beam reinforcement members 22, 24, 26 are installed in the inside of the tank body 10 to reinforce the tank body 10. The stay reinforcement members 22 are installed between the edges of the plurality of the first unit panels 10a arranged adjacent and engaged integrally and the edges of the second unit panels 10b arranged adjacent and engaged integrally to form a ceil surface so that the both ends of them can be spaced apart from each other. The stay reinforcement members 22 are preferable to be installed at the corners of the unit panels

10a, 10b.

- [41] The beam reinforcement members 24, 26 are configured to form the sides of the tank body 10 and are installed between the edges of the plurality of the second unit panels 10b engaged integrally with each other and be opposed so that both ends of them can be spaced apart. The beam reinforcement members 24, 26 are preferable to be installed at the corners of the second unit panel 10b.
- [42] FIGs. 3 to 6 are cross-sectional views of the principal portion of FIG. 1.
- [43] Referring now to FIGs. 3 to 6, the metal tank of the present invention is consisted of the first unit panel 10a made by stacking a synthetic resin sheet 11, a first metal plate 13, and the thermal insulation material 15 in order, and the second unit panel 10b made by stacking a synthetic resin sheet 11, a first metal plate 13, the thermal insulation material 15, and a second metal plate 17 in order.
- [44] Here, the synthetic resin sheet 11 is made of a polyethylene (P.E.) harmless to the human body, and is especially adaptable to a material for the water-purifying tank.
- [45] Also, the first metal plate 13 is made of the galvanized iron plate in place of the high-cost stainless steel, and the second metal plate 17 is made of a colored steel plate in place of the high-cost stainless steel, which is not required of separate painting, and the like.
- [46] Further, the thermal insulation material 15 is made of a foam shaped urethane, which is excellent in buffer property, thermal insulation property, and earthquake resistant property.
- [47] With regard to the thickness of the constructing elements, it is preferable that they have thinner thickness in the order of the thermal insulation material 15, the synthetic resin sheet 11, the first metal plate 13, and the second metal plate 17.
- [48] An adhesive 12 is applied at an interface between the synthetic resin sheet 11 and the first metal plate 13 of the first and second unit panels 10a, 10b to thereby produce complete close contacts between them.
- [49] Here, as described above, the securing means 30 engages the bent edge portions of the adjacent first and second unit panels 10a, 10b with each other at the outside of the tank body 10. The securing means 30 consists of an engaging reinforcement plate 30a inserted and arranged at the corners of the contacted unit panels 10a, 10b, an engaging screw 30b passing through one side of the engaging reinforcement plate 30a, the bent edges of the unit panels 10a, 10b, and the other side of the engaging reinforcement plate 30a, and a nut 30c engaged at one end of the engaging screw 30b.
- [50] FIG. 7 is a perspective view showing a unit panel with a synthetic resin sheet, to which an engagement member is attached, according to the second embodiment of the present invention, and FIG. 8 is a cross-sectional view of FIG. 7 taken along line A - A. Referring to FIGs. 7 and 8, the unit panel 500 of the present invention comprises an

upper plate 510, a side plate 520 formed by vertically bending the rectangular surface of the upper plate 510, and a plurality of engaging members 550 provided to pass through the upper plate 510.

[51] The upper plate 510 is formed with a recess, center of which is formed to be depressed in the downward direction, and an engaging member 550 is provided at the corners thereof.

[52] The side plate 520 is formed with a plurality of engagement holes 532 in the longitudinal direction.

[53] Now, referring to the structure of the unit panel 500 of the present invention, it is constructed that the synthetic resin sheet 561, the thermal insulation material 563, and the second metal plate 565 are stacked in order. The unit panel 500 is also provided with a plurality of engagement members 550 of pipe body shape to pass through the upper plate 510.

[54] Here, the materials of the synthetic resin sheet 561, the thermal insulation material 563, and the second metal plate 565 are respectively a polyethylene, a foam shaped urethane, and a painted color steel plate. Especially, the synthetic resin sheet 561 of the present invention is formed to foam at the upper surface of the thermal insulation material 563 and edges of the second metal plate 565 to radically protect the peeling of the interface due to use of the adhesive 12 (FIGs. 3 to 6).

[55] The engagement member 550 is provided to radically prevent the decrease of the thermal insulation property by the compression of the thermal insulation material 563 at the time of the engagement of the reinforcement member 622 (624; 626) (refer to FIG. 10) with the unit panel 500 by means of the securing means 630, which will be described below. Here, the engagement member 550 is preferable to be made of a metal material or a rigid body of a synthetic resin material having a good strength and hardness.

[56] In the present invention, it is possible to minimize the waste of the materials to thereby reduce the production cost, because it is not required in the unit panel 500 to provide the first metal plate 13 stacked between the synthetic resin sheet 11 and the thermal insulation material 15 of the first embodiment of the present invention due to the provision of the engagement member 550.

[57] The engagement member 550 is inserted and engaged into a through-hole (not shown) in the second metal plate 565 of the unit panel 550 of the present invention, or it is formed integrally with the plate by welding an outer peripheral edge of the engagement member inserted into the through-hole.

[58] The upper surface of the engagement member 550 of the present invention is hermetically sealed the foamed synthetic resin sheet. This is because separate water proof material is required, if the upper surface and the lower surface are of a completely



opened penetrating structure, to accomplish the water proof at the time of the reinforcement. In other words, in the present invention, as the upper surface of the engagement member 550 is hermetically sealed the foamed synthetic resin sheet 561, it is possible to accomplish the water-proof without any separate water proof material at the time of construction.

[59] Further, as shown in FIG. 8, the lower surface of the engagement member 550 is open, however, it may be closed according to the existence of the reinforcement.

[60] FIG. 9 is a partially taken perspective view of the metal tank with the synthetic resin sheet according to the present invention. Referring now to FIG. 9, the metal tank of the present invention has a structure that it is located stably in the foundation plate 800 provided on the upper surface of the pad portions 700 made of the concrete material and separated from each other.

[61] The metal tank of the present invention comprises a tank body consisted of a plurality of the first unit panels 500a constituting the lower surface and the second unit panel 500b constituting the side surface and the upper surface, the inlet pipe 640, the overflow pipe 660, and the air vent 680, communicating respectively with the upper portion of the tank body 600, and the drain pipe 670 and the outlet pipe 650 communicating respectively with the lower portion of the tank body 600. In this regard, the ladder 690 is also provided at the outer surface of the second unit panel 500b for the purpose of use, cleaning the inside of the tank, and repair and conservation.

[62] Here, the inlet pipe 640 and the air vent 680 are communicated with the upper surface of the second unit panel 500 constituting the upper surface of the tank body 600, and the overflow pipe 660 is communicated with the upper side surface of the second unit panel 500 constituting the side of the tank body 600. Also, the drain pipe 670 is communicated with the first unit panel 500a, and the outlet pipe 650 is communicated with the lower side surface of the second unit panel 500 constituting the side of the tank body 600.

[63] The edges of the first and second panels 500a, 500b are bent to the outside direction, and the adjacent unit panels 500a, 500b are positioned to be close adhered to each other at the bent surfaces to thereby be engaged with each other in the outside direction of the tank body 600 by the securing means 630. Also, in the present invention, a plurality of stay reinforcement members 622 and a plurality of beam reinforcement members 624, 626 are installed at the inside of the tank body 600 to reinforce the tank body 600.

[64] The stay reinforcement members 622 are installed such that both ends of the respective reinforcement member 622 are spaced apart between the edges of the plurality of the first unit panels 500a arranged adjacent and engaged integrally, and the edges of the plurality of the second unit panels 500 constituting the upper surface and

arranged adjacent and engaged integrally to constitute the ceil surface. Here, it is preferable for the stay reinforcement member 622 be installed at the corners of the unit panels 500a, 500. The beam reinforcement members 624, 626 form the side surface of the tank body 600, and are installed that both ends of them be spaced apart between the edges of the plurality of the second unit panels 500 adjacent and opposing to each other and engaged integrally. Here, the beam reinforcement members 624, 626 are preferable to be installed at the corners of the second unit panel 500.

[65] FIG. 10 is an enlarged cross-sectional view of the engaging portion of the unit panel and the reinforcement member of the present invention. Referring to FIG. 10, the present invention prevents the reduction of the thermal insulation property radically due to the compression of the thermal insulation material 13(refer to FIGs. 3 to 6) by providing the unit panel 500 attaching the engagement member 550 to prevent the unit panel 500 from being compressed in the engagement between the unit panel 500 and the corresponding respective reinforcement member 622, 624, 626 by means of the securing means 630.

[66] At first, the securing means 630 is comprised of an engaging reinforcement plate 630a arranged at corner of the adjacent unit panel and formed with an engagement hole (no numeral), an engaging screw 630b configured to be inserted into the engagement hole of the engaging reinforcement plate 630a, and a nut 630c engaged with one end of the penetrated engaging screw 630b. Here, the detailed explanation about the sectional structure and constitution of the unit panel 500 will be abridged because they have been explained in FIGs. 7 and 8.

[67] With regard to the engagement, the engaging screw 630b passes through the engagement hole of the engaging reinforcement member 630a, the through-hole of the engagement member 550, and the engagement hole (no numeral) of the reinforcement member 622, 624 and 626 sequentially, and the penetrated end can be strongly engaged by the nut 630c. Here, as shown in FIG. 5, with the upper surface of the engagement hole in the engagement member 550 be hermetically sealed the synthetic resin sheet 561, the engaging screw 630b penetrates through the synthetic resin sheet 561 and passes through the engagement hole of the engagement member 550. In this regard, the synthetic resin sheet 561 functions as a packing for sealing.

[68] The present invention is constructed that the engagement member 550, which is made of the rigid body, supports the unit panel 500 so that it is not compressed, at the time of the engagement of the unit panel 500 and the reinforcement members 622, 624, 626 by means of the securing means 630. Accordingly, it is possible to prevent the reduction of the thermal insulation property radically due to the compression of the thermal insulation material 13 (refer to FIGs. 3 to 6) of the first embodiment.

[69] Although the present embodiment only has explained about the second unit panel

500, as the same explanation can be applied to the first embodiment, the detailed explanation about it is abridged. Whereas, the only difference existed between the first and second panels 500a, 500 is the cross-sectional structure (refer to FIG. 13).

[70] FIG. 11 is a cross-sectional view showing a portion of the metal tank shown in FIG. 9. FIGs. 12 and 13 are enlarged cross-sectional views of the portions "A-1", and "B-1".

[71] Referring now to FIGs. 11 to 13, the metal tank of the present invention is consisted of the first unit panel 500a made by stacking a synthetic resin sheet 561, a first metal plate 567, and a thermal insulation material 563 in order, and the second unit panel 500 made by stacking a synthetic resin sheet 561, a thermal insulation material 563, and a second metal plate 565 in order. Here, the synthetic resin sheet 561 is made of the polyethylene (P.E.) harmless to the human body, and is especially adaptable to the material for the water-purifying tank. Also, the first metal plate 567 is made of the galvanized iron plate in place of the high-cost stainless steel, and the second metal plate 563 is made of a color steel plate in place of the high-cost stainless steel as described above, which is not required of separate painting, and the like.

[72] Further, the thermal insulation material 563 is made of the foam shaped urethane, which is excellent in buffer property, thermal insulation property, and earthquake resistant property.

[73] With regard to the thickness of the constructing elements, it is preferable that they have thinner thickness in the order of the thermal insulation material 563, the synthetic resin sheet 561, the first metal plate 567, and the second metal plate 565.

### **Industrial Applicability**

[74] As described above, the present invention relates to a metal tank with a synthetic resin sheet and a unit panel, which is constructed by engaging a plurality of unit elements in correspondence with the desired volume, each of which is fabricated by attaching a polyethylene sheet harmless to the human body on a portion of one surface of a galvanized iron plate and filling a urethane resin between the other surface of the galvanized iron plate and a metal plate, thereby ensuring excellence in cost competitiveness and waterproof property and durability while being harmless to the human body.

[75] While the present invention has been described with reference to the preferred embodiments, the present invention is not restricted by the embodiments. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention. However, such variations and modifications are all pertained to the scope of the present invention.